

# **Wisconsin Highway Research Program**

## **Work Plan: Evaluation of Performance of Innovative Bridges in Wisconsin**

Wisconsin Highway Research Program  
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**Iowa State University  
8/28/2014**

<b>Project Title:</b>	Evaluation of Innovative Bridges in Wisconsin
<b>Proposing Agency:</b>	Iowa State University Institute for Transportation – Bridge Engineering Center 2711 South Loop Drive, Suite 4700 Ames, IA 50010 (515) 294-8103
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<b>Proposal Date:</b>	January 24, 2014
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<b>Proposed Contract Period:</b>	15 months
<b>Total Contract Amount:</b>	\$64,958.24
<b>Indirect Cost Portion at 26%</b>	\$13,404.08

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## **PROPOSAL: Evaluation of Performance of Innovative Bridges in Wisconsin**

The Iowa State University (ISU) Bridge Engineering Center (BEC) is pleased to submit this proposal to the Wisconsin Highway Research Program in response to, and in compliance with, the agency solicitation entitled “Evaluation of Performance of Innovative Bridges in Wisconsin.” This proposal describes the relevance, quality, and extent of our past experience in bridge engineering, innovative bridge concepts and bridge materials, and performance evaluation. A Work Plan to achieve the project objectives as well as previous experience information for the principal staff selected to undertake this study are provided.

We have thoroughly reviewed the Solicitation and understand the needed project tasks and goals. Furthermore, we support this endeavor and stand ready to contribute the necessary resources for the success of the project. The Work Plan contains the necessary elements to successfully complete this project within the prescribed constraints.

The BEC offers the finest resources and talents in various fields of bridge engineering. Our past experience providing innovative bridge evaluation research services to the transportation industry demonstrates our ability to deliver ready to use products to a wide variety of State Departments of Transportation.

### **Research Plan**

Over the past decade or so, a number of programs have existed to provide bridge owners with funding to cover “delta” costs associated with implementing new and innovative bridge technologies. While these programs generally provided funding for a “research” component, it has not been uncommon for the innovative concepts to be “shelved” one or two years after initial trial. The research plan described below will provide a much needed review of the performance of innovative bridges after several years of service. Such a review, especially within the context of future usage and adoption, will provide WisDOT with information that may lead to further implementation, modifications, or even abandonment of the innovative bridge concepts. Further, as one of the nation’s preeminent institutions in the field of Accelerated Bridge Construction (ABC), the performance evaluation will offer a unique perspective on the applicability of the innovations in an ABC environment.

### **Background**

Principally starting with the Federal Highway Administration (FHWA) Innovative Bridge Research and Construction (IBRC) program, a number of highway agencies have constructed bridges with innovative materials, concepts, or design features with the associated “delta” costs covered by non-traditional sources. In many cases, these projects have provided a great opportunity for owners to minimize the risk sometimes associated with using atypical solutions. In fact, the BEC at ISU has been involved with a number of such projects – a partial list includes:

- East 12<sup>th</sup> street bridge – high performance steel superstructure
- Delaware County – FRP strengthened timber girder superstructure
- Buchanan County – UHPC “pi” girder
- 24<sup>th</sup> Avenue bridge – FRP panel bridge deck
- Temporary bridge system – full-depth FRP superstructure/deck system
- Buchanan County – “Launched” superstructure system for low-volume roads
- 24<sup>th</sup> Street bridge – post-tensioned deck system for ABC
- Wapello County – UHPC prestressed girder system
- Pottawatamie County – FRP post-tensioned strengthening system

- Buchanan County – internal curing concrete
- Guthrie County – FRP plate strengthening system
- Broadway Viaduct – lightweight concrete fill and post-grouted drilled shaft
- Buchanan County – folded plate girder system
- Lightweight bridge deck system – composite internal curing concrete deck
- Buchanan County – 100% galvanized steel bridge
- Madison County – innovative adjacent box beam bridge for ABC
- O’Brien County – precast approach system and innovative connection detailing
- Grundy County – corrosion resistant reinforcing steel

As the above partial list suggests, the BEC is well versed and experienced in the evaluation of innovative bridge concepts. Since approximately 2001 we have developed bridge evaluation protocols, approaches, and methodologies that are particularly suited to evaluating atypical bridge technologies. This unique historical experience is just one of the factors making ISU the ideal candidate to complete this research.

It is also worth pointing out that the team proposing here is completing similar work for the Iowa DOT. Since the early 2000’s the Iowa DOT, Iowa Counties, and Iowa Cities have applied for and been awarded innovative bridge construction grants. Those grants typically involve an evaluation component that lasts for approximately 2 years. To follow-up on the performance of those bridges, we have been contracted to document the condition and performance of three of those innovative bridges each year. The lessons learned while completing those follow-up evaluations have been instrumental in the creation of the research approach described below.

## **Research Objectives**

The objectives of this research are:

- Document the long-term performance of innovative bridge construction technologies.
- Document the benefits (or lack thereof) of innovative bridge technologies

## **Research Approach**

The research approach summarized below is believed, based upon the research team’s significant experience with evaluating innovative bridge concepts, to meet the objectives of the proposed work. The work is divided into three tasks. During Task 1, the research team will review available information on the 12 bridges to be evaluated in this study. Ideally this information will be in the form of previous inspection reports, design calculations, previous test result reports, and plan sets. During Task 2, the research team will conduct field inspection and testing of the 12 innovative bridges with the goal of collecting quantitative and qualitative information on various performance aspects of the bridges that may have been influenced by the innovative technology/technique utilized. During Task 3, the research team will prepare a final report that documents the entire project effort. Since this work is essentially a performance review of 12 individual bridges, we propose to compile the final report as a collection of 12 mini-reports. Each mini-report will document:

- (1) innovation(s) utilized,
- (2) performance evaluation results and summary,
- (3) discussion of the factors contributing to the success or failure of the innovations,
- (4) suggested future application scenarios,
- (5) recommendations for implementation, and
- (6) suggested specifications, design methods, and construction techniques associated with future implementation.

## *Work Plan/Experimental Design*

### **Task 1 – Information Review and Synthesis**

During Task 1, information on the 12 innovative bridges will be sought, collected, reviewed, and summarized. The principle source of information will come in the form of previous inspection reports, design calculations, previous test reports, plan sets, and original research reports/supporting documents. Once all pertinent information is collected for the specific bridges, the research team will summarize the bridge holistically as well as the innovations utilized. Further, when available, the summary will include information on the documented performance (or change in performance) since original construction. At a minimum, this should be documented in field inspection reports. In addition to summarizing information on the specific 12 bridges, the research team will do a brief search for applications similar to those completed in Wisconsin. This scan will include other bridge in Wisconsin where similar technologies to those used in the innovative bridge have been used. If similar applications can be identified, inspection/test/research results associated with those applications will be reviewed, summarized, and included in the report to be compiled in Task 3.

### **Task 2 – Field Performance Evaluation and Testing**

During Task 2, the research team will complete site visits at each of the 12 innovative bridges (summarized below in Table 1 with key innovative feature) identified in the project RFP (the 12 site visits will be conducted during a single trip). During each site visit the research team will conduct, at a minimum, detailed, arms-length visual inspections of all elements of the bridge that are accessible without the use of traffic control and/or specialized access equipment. To remotely view inaccessible areas binoculars will be used as appropriate. In addition to using visual inspection approaches, the research team will utilize sounding techniques to investigate the condition of individual components. During the visual inspections the research team will document the condition of the entire structure (both innovative and non-innovative portions). If there are changes in condition of the non-innovative portions that may be attributable to the use of innovative approaches, special notes will be made. During all inspections the research team will document their findings in both text and photographic formats. When practical, feasible, safe, and beneficial, the research team will also install instrumentation on relevant structural members. The instrumentation would then be monitored while ambient traffic crosses the bridge (i.e., the bridge will not be closed to traffic for controlled testing). This field testing approach will give a general – yet solid – understanding of how the innovative bridges are performing under real world live loads. In cases where a conventional “twin” is adjacent to the innovative bridges, the same evaluation process used on the innovative bridge will be repeated on the conventional bridge. Further if an adjacent “twin” is not available a similar bridge nearby on the same roadway will be attempted (with project constraints such as schedule, budget, etc.)

The above description of the inspection and testing procedures will serve as the minimum inspection/testing that will be conducted. However, when state crews/resources or county crews/resources can be arranged to provide inspection equipment and/or traffic control the research team will work with the POC to conduct more extensive inspections/testing utilizing this equipment. It is important, however, to also recognize and work within the inspection/testing time proposed for this task. Simply put, the research team will work with the POC on getting the most information possible under the project constraints (e.g., equipment availability, schedule, budget, etc.)

Table 1. Innovative Bridges

Bridge	Feature on	Feature over	Innovation	Parallel?
B050311	USH 141	Fox River	Exodermic deck	
B200133	USH 151 NB	STH 26	FRP deck	Yes
B200148	USH 151 NB	Deneveu Creek	FRP deck	Yes
B130161	IH 90 WB	Door Creek	Post-tensioned deck panels	Yes
B450095	STH 33	Milwaukee River	Post-tensioned deck	
B401132	Ramp IH43 NB	794	Stainless steel bars	
B270150	USH 12E	Coffee Creek	Steel free with tension rods	
B550217	USH 63	Rush River	Precast abutments	
B050613	USH 41	Ashwaubenon Creek	Precast inverted T	
B400433	USH 18-STH 100	CNW RR	Precast inverted T	
B400718	29 <sup>th</sup> St	UPRR	Precast inverted T	
B090380	STH 40	Hay Creek	GRS Abutment	

During the field performance efforts and in the subsequently described reporting, the research team will routinely seek to assess the future “likelihood of success” by asking questions such as:

- Does this innovation address a current need in bridge engineering/construction? Do other alternatives also exist?
- Does this innovation have any constructability concerns?
- Does this system appear to have durability and quality characteristics similar to other bridge components?
- Does this system allow for reasonable maintenance?

Prior to initiating Task 2, the research team will submit an inspection and instrumentation plan to the POC for review and comment.

### **Task 3 - Reporting**

Based upon the information collected in Tasks 1 and 2, a series of mini-folders will be compiled that consist of inspection reports, design computations, plans, etc. for each of the 12 innovative bridges. Additionally, a final report for each bridge/technology will be prepared. Each report will be written with the same organizational structure as outlined below:

1. General information
2. Description of innovative feature(s) including design approaches and philosophies
3. Use of innovative feature(s) in other bridges
4. Visual inspection results
5. Field test results
6. Performance evaluation and summary
7. Factors contributing to success/failure of the innovations
8. Recommended future application scenarios
9. Recommended modifications to design details, specifications, and construction methods
10. Recommendation for general implementation and implementation in ABC projects
11. Suggested specifications, design methods, and construction techniques

A draft of the final reports will be submitted a minimum of three months prior to the contract end date for review by the POC.

*Expected Contribution from WisDOT Staff:*

WisDOT/TOC Staff Time

We anticipate needing the assistance of WisDOT staff to identify available in-house information on each of the 12 innovative bridges. At a minimum, the research team would like to obtain copies of previous inspection reports, plan sets, design information, research reports, testing reports, photographs and location information.

Equipment

As can be arranged, WisDOT inspection equipment and traffic control may be utilized for some bridge inspections/testing.

*Other (donated) Equipment and Materials*

Equipment

No equipment donations have been assumed in the preparation of this proposal.

Materials

No materials donations have been assumed in the preparation of this proposal.

**Anticipated Research Results and Implementation Plan**

The product of this research will be: (1) documentation of the long-term performance of innovative bridge technology, (2) a presentation of the benefits derived from using innovative bridge technology, and (3) recommendations for future adoption and implementation of specific innovative technologies (with particular interest in ABC applications). These research results will be derived by completing a review of available information on the 12 innovative bridges identified in the project RFP, reviewing information on application(s) of similar innovations on other bridges, (3) a critical quantitative and qualitative field inspection and testing program, and (4) engineering-based analysis and reporting. The intended audience of this work will include various offices throughout WisDOT including the bridge office, materials office, and construction offices, among others. The only significant impediment to implementation would be if the research results were categorized as inconclusive. Given the research team's past experience in this area, this is viewed as a very small likelihood. Principal activities leading to successful implementation will hinge very much on departmental acceptance of the past performance documentation and the subsequent modification to department standard practice(s).

**Time Requirement**

The anticipated project schedule is shown below. The research team proposing here believes that the work can be completed in 12 months and proposes a project duration of 15 months (including 3 months of review by the TOC). The summary of all project staff hours is also shown below.



## Project Schedule

	Oct-14	Nov-14	Dec-14	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	Nov-15	Dec-15
Task 1 - Information review															
Task 2 - Field Evaluation															
Task 3 - Reporting															
TOC Review, revision and final submission															

## Summary of Hours

INDIVIDUALS	TASKS			TOTAL HOURS
	1	2	3	
Principal Investigator - Brent Phares	15	15	50	80
Travis Hosteng	20	80	60	160
Justin Dahlberg	80	100	420	600
<b>TOTALS</b>	115	195	530	840

## Budget

### Work Effort by Task

INDIVIDUALS	TASKS			Total Salaries	Fringes	Total Salaries and Fringes
	1	2	3			
Principal Investigator - Brent Phares	\$ 1,018.35	\$ 1,018.35	\$ 3,394.50	\$ 5,431.20	\$ 2,052.99	\$ 7,484.19
Travis Hosteng	\$ 695.80	\$ 2,783.20	\$ 2,087.40	\$ 5,566.40	\$ 2,104.10	\$ 7,670.50
Justin Dahlberg	\$ 2,498.40	\$ 3,123.00	\$ 13,116.60	\$ 18,738.00	\$ 7,082.96	\$ 25,820.96
<b>TOTALS</b>	\$ 4,212.55	\$ 6,924.55	\$ 18,598.50	\$ 29,735.60	\$ 11,240.06	\$ 40,975.66

## Itemized Budget

	Task 1	Task 2	Task 3	Year 1*	Year 2	TOTALS
<b>Total Salaries, Wages and Fringes (From Table 1)</b>	\$ 5,804.89	\$ 9,542.03	\$ 25,628.73	\$ 40,975.66		\$ 40,975.66
<b>Sub-Contracts (Please list each subcontract separately)</b>						
<i>Subcontractor 1 (Provide Name)</i>						\$ -
<i>Subcontractor 2 (Provide Name)</i>						\$ -
<b>Subtotal</b>	\$	\$ -	\$ -			\$ -
<b>Other Direct Costs</b>						
<i>Laboratory equipment usage fees</i>		\$ 5,000.00		\$ 5,000.00		\$ 5,000.00
<b>Subtotal</b>		\$ 5,000.00		\$ 5,000.00		\$ 5,000.00
<b>Materials &amp; Supplies (List all items over \$1000 separately)</b>						
<i>Field testing supplies (paint, glue, etc.)</i>		\$ 450.00		\$ 450.00		\$ 450.00
<b>Subtotal</b>		\$ 450.00		\$ 450.00		\$ 450.00
<b>Travel (State number of trips and estimated cost/trip)</b>						
<i>Trip 1 - Kick off meeting</i>	\$ 660.00			\$ 660.00		\$ 660.00
<i>Trip 2 - Field inspection/testing</i>		\$ 2,173.50		\$ 2,173.50		\$ 2,173.50
<i>Trip 3 - Project wrap-up</i>			\$ 1,320.00	\$ 1,320.00		\$ 1,320.00
<b>Subtotal</b>	\$ 660.00	\$ 2,173.50	\$ 1,320.00	\$ 4,153.50		\$ 4,153.50
<b>Communications (Printing is required)</b>						
<i>Printing (8 printed final reports)</i>			\$ 25.00	\$ 25.00		\$ 25.00
<i>Communications services</i>			\$ 950.00	\$ 950.00		\$ 950.00
<b>Subtotal</b>			\$ 975.00	\$ 975.00		\$ 975.00
<b>TOTAL DIRECT COSTS</b>	\$ 6,464.89	\$ 17,165.53	\$ 27,923.73	\$ 51,554.16		\$ 51,554.16
<b>TOTAL INDIRECT COSTS (26%)</b>	\$ 1,680.87	\$ 4,463.04	\$ 7,260.17	\$ 13,404.08		<b>\$ 13,404.08</b>
<b>Fixed Fee if Applicable</b>						<b>\$ -</b>
<b>TOTAL CONTRACT COST</b>	<b>\$ 8,145.77</b>	<b>\$ 21,628.57</b>	<b>\$ 35,183.90</b>	<b>\$64,958.24</b>		<b>\$ 64,958.24</b>

## Budget Justification

The hourly rate indicated in the proposal is determined by dividing the employee's annual salary by 2088 working hours per year. Iowa State University's accounting system does not allow for the recording of timesheets; salaried employees pay is assigned to accounts based on planned effort and later verified thru Iowa State University's effort reporting system. The percentage of effort method for salary charges is as permitted by 2 CFR 220, Cost Principles for Educational Institutions, Section J. 10. b. 2 CFR 220 is incorporated in the FAR in section 31.3., and approved by the Department of Health and Human Services, which is the cognizant audit agency for the university.

Fringe benefits are estimated by staff/employee classification for budgeting purposes only; 37.8% for Professional & Scientific. Actual charges for individuals may differ slightly in percentage and actuals are charged. <http://www.ospa.iastate.edu/policies/benefits.html>

Charges for printing/copying are tracked using project codes specific to each project. Copying is \$.05 per b/w copy and \$.50 per color copy. Copying is for interim and final report copies.

Supplies are for consumable supplies for laboratory testing.

Lab testing is for testing as described in the proposal.

Communication Services is a publications cost center at ISU and billable at \$47/hour including fringe benefits. The cost center maintains editors for interim and final reports, graphic designers and webmasters.

Travel costs are for the researchers to travel to Wisconsin for bridge inspection and to meet with project monitors. Iowa State University travel policies are used for the estimate. Meals are billed at actual expenses not to exceed \$8/breakfast, \$12/lunch, \$20/dinner. Hotel rates are actual rates, reasonable hotels are used. (ISU employees are not federal employees so they are not eligible for federal hotel rates).

Details for the trips are given below.

Trip 1 \$660

1 person

3 days/2 nights

Meals: \$40/day/person -\$120

Hotel: \$120/night/person - \$240

Airfare and rental car - \$300

Trip 2 (field testing) \$2,173.50

2 people

6 days/5 nights

Meals: \$40/day/person - \$480

Hotel: \$120/night/person - \$1,200

1050 miles .47/mile - \$493.5

Trip 3 \$1,320

2 people

3 days/2 nights

Meals: \$40/day/person -\$240

Hotel: \$120/night/person - \$480

Airfare and rental car - \$600

**Qualifications of Research Team**

Iowa State University is a premiere engineering institution with an exemplary record of practical and applied research at the Institute for Transportation (InTrans) and in the Department of Civil, Construction

and Environmental Engineering. ISU researchers are primarily focused on transportation with a very strong focus in the area of bridges and structures. Through the years, ISU researchers have become the trusted partners and advisors to the Iowa DOT and also to many counties and county Engineers throughout the State. It is important to note that ISU is recognized as having the #1 ranked Construction Engineering program in the nation. In all, the ISU team possess exemplary capabilities in both areas of bridge engineering and construction, in which this proposed work shows significant needs.

The Bridge Engineering Center was established in 1986 with the mission to provide cost-effective bridge engineering solutions to bridge owners at the federal, state, and local levels, is currently housed within InTrans. The BEC manages several million dollars of bridge research per year. Major focus areas of the center are bridge construction monitoring and evaluation, Accelerated Bridge Construction, bridge structural health monitoring, remote and autonomous evaluation technologies, methodologies for incorporating bridge performance data into active bridge management solutions, application of advanced structural materials, use of timber in transportation structures, and the development of low-cost bridge replacement, repair, and rehabilitation solutions that can be quickly implemented.

The BEC employs 4 full-time staff, several part time staff, and ISU faculty who manage and perform bridge related research projects along with over 20 M.S. and Ph.D. graduate students. One unique aspect of the BEC is the contractual relationship with the Office of Bridges and Structures at the Iowa DOT in which the BEC essentially functions as an extension of the Iowa DOT in assisting with research, specialty bridge projects, and training. It is noteworthy that the BEC has field tested over 300 bridges in the past 15 years in Pennsylvania, New York, North Carolina, Alabama, Florida, Colorado, Texas, Wisconsin, Iowa, Montana, Oregon, and Washington.

Dr. Phares, PE – the project Principal Investigator – has over 19 years of experience in the field of Civil and Structural Engineering. After graduating from ISU, Dr. Phares worked as a consultant to the Federal Highway Administration with assignment at the Turner-Fairbanks Highway Research Center in McLean, VA. In that role, Dr. Phares was responsible for the development and evaluation of nondestructive bridge evaluation technologies and for the development of implementable guidelines/specifications/manuals for application of those technologies. Although just two of the products of his work at the FHWA, Dr. Phares was responsible for (1) leading an evaluation of NBIS-style bridge inspections and (2) the development of a guideline/specification/manual for the ultrasonic inspection of bridge piers. Collectively, these publications have had a lasting impact on the manner in which bridges are evaluated. Since joining ISU in 2001, Dr. Phares has transitioned from a Research Engineer to now being the Director of the Bridge Engineering Center which employs research staff, graduate students, and collaborates with faculty from across ISU and with professional staff from across the United States and beyond. Dr. Phares is considered an international expert in the field of bridge evaluation using quantitative information and has become a national expert in the field of ABC. Dr. Phares currently has a rolling, three year contract with the Iowa DOT to provide “on-demand” research and other expertise. This relationship exemplifies the relationship between himself and a State DOT considered to be at the forefront of bridge engineering innovation. One of Dr. Phares’ key attributes is his ability to manage large projects, produce timely and results oriented research that meets stakeholder needs, and to listen to and meet client needs. Dr. Phares regularly integrates outreach activities into research to act as a conduit between the academic community and transportation practitioners thus allowing technology and research results to be quickly adopted. Dr. Phares sets a high standard for all BEC staff with respect to Service, Quality Products, Teamwork, Objectivity, and Ethics.

Justin Dahlberg, PE is a research engineer for the BEC at ISU. He received his M.S. in structural engineering in 2007 following the completion of his Bachelor’s degree in Civil Engineering at the University of Wisconsin-Platteville in 2005. While in graduate school Dahlberg spent the majority of his time conducting investigative bridge research and performing load testing of bridges in six geographically

diverse states. During that work, he gained significant experience in the statistical evaluation of large amounts of data. Following completion of his graduate degree, Dahlberg spent three years designing structures for a private consulting firm where he had the opportunity to design structures for several multi-million dollar projects. As a result of that work, Dahlberg is proficient at creating and applying standards and specifications. Since joining the Iowa State University staff in 2010, Dahlberg has conducted numerous live-load bridge tests and has worked on projects involving structural health monitoring, material performance, repair and rehabilitation, and bridge performance.

Travis Hosteng, PE is a research engineer with the BEC at Iowa State University. After receiving his B.S. and M.S. degrees, he continued his career as a research engineer for the BEC. Mr. Hosteng has directed and contributed to multiple bridge related research projects funded by state, federal, and industrial clients. His specialty areas include timber design, high performance material behavior, structural health monitoring, and bridge behavior and testing. Mr. Hosteng is a recognized authority in field testing of bridges, application of various sensor systems (strain, deflection, rotation, etc.), analysis of field collected data for the purpose of load rating (including both direct application of performance data and the creation of calibrated finite element models), and timber bridge engineering. Overall, he has nearly 11 years of experience with nearly 9 years of experience designing, inspecting, instrumenting and full-scale load testing bridges and other transportation structures. Mr. Hosteng is a registered professional engineer in the state of Iowa and is a member of TRB, ASCE, and other professional organizations.

#### **Other Commitments of the Research Team**

<b>Research Team Commitments</b>			<b>Percentage of Time</b>	
<b>Team Member</b>	<b>Role</b>	<b>Activity</b>	<b>Committed</b>	<b>Available</b>
Brent Phares	Principal Investigator	Activity 1: Iowa DOT Bridge Engineer Contract	75%	
		Activity 2: NCHRP 12-95	2%	
		Activity 3: Wisconsin DOT approach slab project	2%	
		Activity 4: Wisconsin DOT granular backfill project	1%	
		Activity 5: SHM Pooled fund project	5%	
		Activity 6: Iowa ABC program	5%	
		<b>Total</b>	<b>90%</b>	<b>10%</b>
Justin Dahlberg	Engineer	Activity 1: MnDOT Timber Bridge repair manual	46%	
		Activity 2: Wisconsin DOT approach slab project	12%	
		Activity 3: Iowa DOT Deck evaluation program	12%	
		Activity 3: Iowa DOT ABC Connection detail testing	4%	
		<b>Total</b>	<b>74%</b>	<b>26%</b>
Travis Hosteng	Engineer	Activity 1: Timber Bridge Center	25%	
		Activity 2: Load testing program	27%	
		Activity 3: ABC Specification Development	15%	
		Activity 4: Wisconsin DOT granular backfill project	4%	
		Activity 5: ABC-UTC Administration	4%	
		<b>Total</b>	<b>75%</b>	<b>25%</b>

#### **Facilities and Information Services**

The project team is fully equipped to provide the services as proposed herein. The Institute for Transportation (InTrans), where this project will be mainly administered and conducted, is located in a

25,000-square-foot office suite in the Iowa State University Research Park, roughly three miles from both the university campus and the Iowa DOT headquarters in Ames, Iowa. The facility includes: state-of-the-art computing hardware and software, including desktop publishing equipment and a T1 connection to the university's communications backbone, a geographic information systems (GIS) lab (with eight computers plus peripherals—digitizing table, flatbed scanner—used for application of GIS for transportation), the Bridge Engineering Center Structural Health Monitoring Laboratory, a videoconference classroom, a transportation technology transfer library, and unlimited access to the Iowa DOT library and librarian services

Iowa State's high-speed computing network supports services for instruction and research and access to off-campus sites, including those offering supercomputers. ISU's Instructional Technology Center, with state-of-the-art web-based technologies and other digital resources, serves all campus departments, including CTRE, incorporating interactive web tools into their research, teaching, and outreach activities.

The ISU Structural Engineering Laboratories consist of two primary areas that allow for the testing of full scale structural models and system components. Both areas are located in the Town Engineering building on the northwest side of campus. The department of Civil, Construction and Environmental Engineering operates these laboratories in coordination with the Bridge Engineering Center. A major portion of one of the laboratories includes an 80-ft × 25-ft structural tie-down floor with a load capacity in excess of 1,000,000 lbs. This space is equipped with a 20-ton overhead crane and has 25 ft ceiling heights. This structural floor permits the testing of large-scale specimens by load application from either above or below the floor. An area below the floor is available for instrumentation and test apparatus. Two forklifts are available for moving smaller specimens around the laboratory spaces.

Major pieces of equipment available for testing include a recently upgraded 400,000 lb capacity universal testing machine with hydraulic tension grip actuators; a 110,000 lb capacity MTS closed-loop fatigue testing frame; two 55,000 lb capacity MTS actuators and one 150,000 lb capacity actuator for structural testing, capable of static, fatigue, real-time dynamic, and sequential dynamic testing. This equipment also has been recently upgraded. There are a number of other general purpose test frames capable of simulated gravity and in-plane shear loads. In addition, 10,000 psi hydraulic systems with a full complement of actuators ranging from 5 to 200 ton capacities are available.

Data collection capabilities (for both field and laboratory use) consist of numerous PC-based systems. These include three HP systems capable of collecting data from various instrumentation types. Two Optim Megadac systems, capable of collecting data up to 250,000 samples per second, are also available for collecting dynamic, 16-bit data. Five Campbell Scientific systems are available for data collection. These systems are typically used for long-term, remote data acquisition but can easily be configured for laboratory use. Instrumentation available includes an assortment of displacement transducers, load cells, accelerometers, and strain sensors.

The structural engineering laboratory also maintains a wide selection of tools. These range from basic woodworking tools to concrete finishing tools to rebar bending machines. In addition, the laboratory has a wide selection of pre-built formwork. These steel forms are true in shape and allow for rapid construction of accurate test specimens.

The Materials Analysis Research Laboratory (MARL) provides researchers the capability to conduct elemental materials analyses by x-ray fluorescence to determine the chemical makeup of cements, fly ashes, limestones, and other materials. Similarly, the Geotechnical Engineering Laboratory includes equipment for index tests, classification of soils and aggregates, and research on permeability, strength, and stress/strain characteristics. A 44 ft mobile geotechnical research laboratory has been designed to focus on soil mechanics, earth structures, foundation, and retaining structures. The mobile laboratory

research is used to better understand engineering properties of soils that relate to performance in highway construction; improve earthwork construction quality and efficiency through the use of current and emerging construction equipment and intelligent construction technologies. The laboratory is fully equipped with all necessary tools and laboratory equipment.

InTrans manages the Iowa DOT Library under contract to the Iowa DOT. The transportation library collects copies of many specialty publications. The librarian provides research services that include Transportation Research Information Service (TRIS), TRIS Research in Progress, and proprietary resources available only to librarians. The Iowa State University library collection includes more than 2 million book volumes, about 22,000 journals and other serial publications, and extensive interlibrary loan capabilities.

**Technician Certifications**

None required.